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LASTING LEGACY IN INTENSIVE CARE MEDICINE

Critical care ultrasound

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The use of ultrasound has become ubiquitous in intensive care units (ICUs) across the world. Its use as a tool for diagnosis, monitoring and guidance for invasive procedures has increased markedly, influencing contemporary intensive care management.

It is important to reflect on the evolution of critical care ultrasound (CCUS) to plot the route ahead for future development. Here, we address three key issues for reflection:

- Defining the competencies
- Training of colleagues
- The future: Does it matter?

Defining the competencies in CCUS

In the 1990s, ultrasound slowly began to emerge from the radiology and cardiology departments into the ICUs of Europe and North America. Given that a core business of intensive care involves the manipulation of cardiovascular physiology and haemodynamics, bedside echocardiography (borrowed from our cardiology colleagues) led this charge. In 1993, this Journal published a remarkable report extending the use of ultrasound to a whole-body approach [1]. All of this seemed fairly intuitive but was met by considerable resistance from colleagues outside intensive care. The lack of formal training pathways or programs meant that intensivists had to develop informal working and teaching relationships in a non-competitive and low-keyed manner with other frontline intensivists who understand the utility of CCUS.

Recognising this, collaborative projects involving like-minded individuals and professional societies culminated in large national level courses both in the United States of America (USA) [2, 3] and Europe (Fig. 1). Several landmark papers were published in subsequent years that defined the various required competencies in both critical care echocardiography and general CCUS [4–7]. National societies started to operationalize recommendations into their own curriculum and training programs.

While there was overlap between the various required competencies of the many stake-holding national societies, key differences led to variations in implementation both from operational and training perspectives. Clarity and transparency (alongside supporting resources) are necessary for setting standards to which both trainers and trainees adhere/aspire. It took more than a decade from these seminal papers before, in 2021, the European Society of Intensive Care Medicine (ESICM) produced the most recent consensus statement with expert recommendations on core CCUS for intensivists working in general ICU and neuro ICU (Fig. 1) [8]. The document included 74 statements: 7 for brain; 20 for lung; 20 for heart; 20 for abdomen; 7 for vascular ultrasound. These represent the most up to date and robust consensus on the required competencies available for CCUS, and they are expected to form the foundation for the development of more advanced skillsets.

Training the intensivists

Whilst agreeing on the competencies is a crucial first step, achievement of these competencies requires educational resources and structured training from critical care training programs and the professional societies. Whilst the ideal situation would be for colleagues to achieve these competencies during their training/fellowship, support for these educational resources should be accessible to all colleagues at all stages of their career.

Despite the continual evolution and update of these guidelines, significant barriers still remain. A consistent challenge has been the lack of both trainers from within the critical care community and support from colleagues

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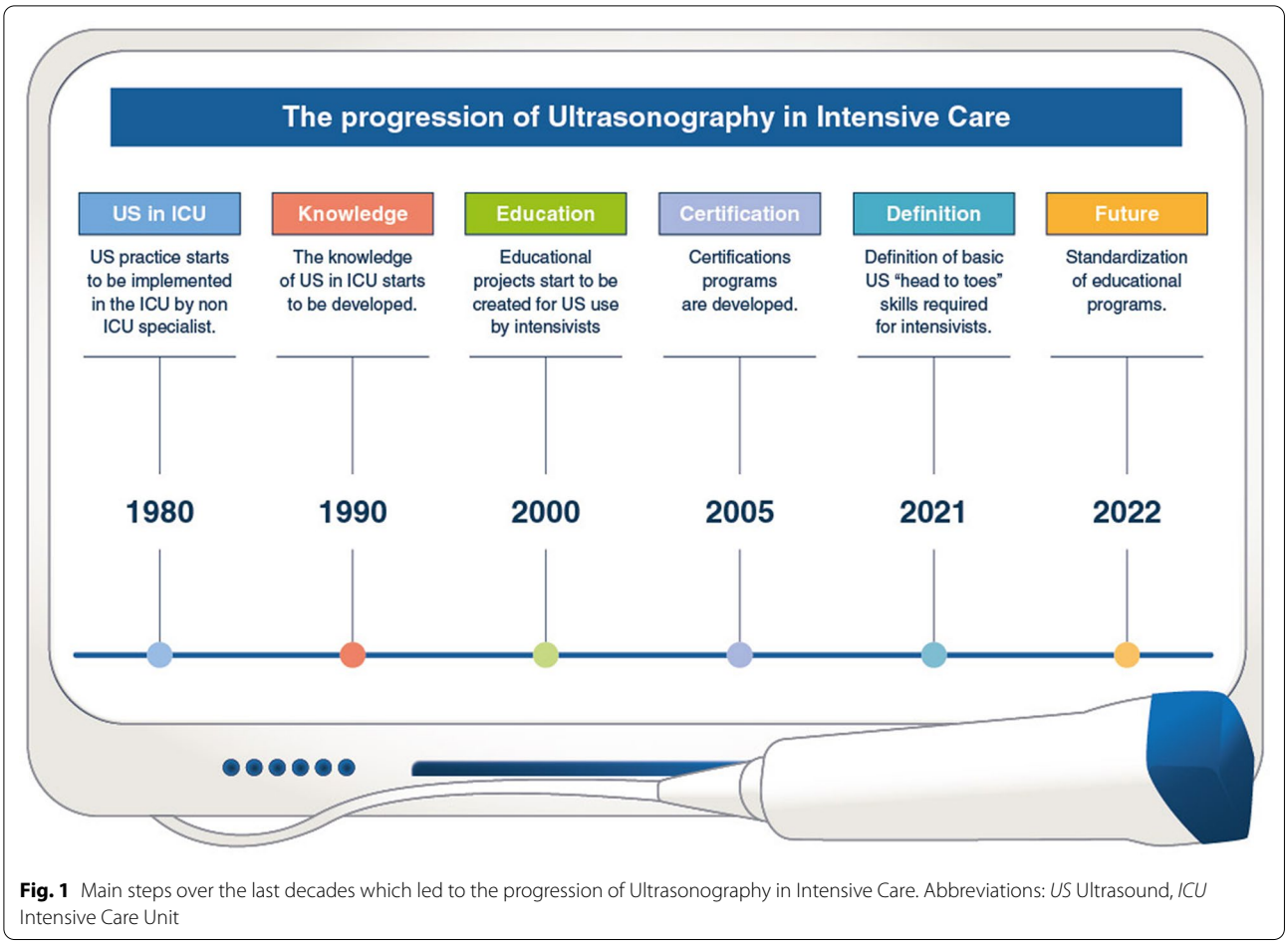

Fig. 1 Main steps over the last decades which led to the progression of Ultrasonography in Intensive Care. Abbreviations: *US* Ultrasound, *ICU* Intensive Care Unit

outside of the ICU. In addition, the lack of a uniform, standardized framework for ultrasound training has been compounded by inconsistent regulatory norms across countries [9], compromising the quality of technical training and level of professional competency.

While the early guidelines stipulated the number of scans that the trainee should log before competency can be achieved, the evidence basis of these numbers is both contentious or lacking. These requirements fail to take into account the remarkable progress in medical education, including the use of technology. Ultrasound training, a dynamic visual-based modality, benefits from readily available online videos to supplement traditional didactic lectures or printed texts. Whilst online resources cannot replace hands-on training in a practical skill such as ultrasound, high-fidelity simulators and virtual reality are able to demonstrate both normal and abnormal images, increasing training opportunities; internet-based education, as exemplified by the Free Open Access Meducation (FOAMed) movement, has great promise in helping to train the new generation of CCUS users.

Outcomes and the future

Just because you can, doesn't mean you should—Sherrilyn Kenyon
First Do No Harm—Hippocrates.

Whilst the use of CCUS to aid procedural skills and management of emergencies (e.g. pericardial effusion) is fairly uncontroversial, the early evidence of benefit in other areas, e.g. fluid management, has been mixed [10]. The reasons for this are likely multifactorial; no monitoring tool/device has ever been shown to improve patient care without being aligned with a coherent treatment strategy. More recent evidence appears more promising [11, 12] and this key uncertainty will require further studies.

In addition, other unanswered questions include quality assurance issues and how best to train colleagues and ultimately operationalize CCUS across hospital departments and healthcare networks (13).

All of these issues will need to be addressed in context of rapid technological advancements such as

ultraportable ultrasonography machines and artificial intelligence/machine learning to aid image interpretation and clinical decision-making.

As critical care is a multidisciplinary specialty, intensivists will continue to collaborate with cardiology and radiology colleagues who provide consultative ultrasonography input. Ultimately, the future of CCUS relies on all intensivists and their colleagues in other specialties acknowledging that it is an integral part of the practice of critical care medicine.

Key questions remain pertaining to how best to train future generations of colleagues in CCUS. Guidelines and consensus statements from professional societies will play a key role, but these need to be supported with effective education pathways, that may include formal examination and accreditation. In addition, there needs to be a robust clinical and data governance structure across healthcare systems, including image storage, archiving, and review process to ensure patient safety.

However, through the legacy of the pioneering generation who adapted ultrasound into patient care in ICUs and those who established the early guidelines, the critical care community has made great strides towards self-sufficiency and sustainability in using CCUS to deliver the best care for our patients.

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Declarations

Conflicts of interest
All authors have no conflicts of interest to declare.

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